

The United States has ratified this STANAG and it is approved for use. Actual promulgation by NATO is expected within one year. At that time, this document will be replaced by the promulgated version. Any U.S. comments or reservations are included in the following letter.



ACQUISITION AND  
TECHNOLOGY

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON  
WASHINGTON DC 20301-3000



June 12, 2002

MEMORANDUM FOR U.S. MISSION TO NATO, ARMAMENTS COOPERATION DIVISION  
(ARMY ARMAMENTS OFFICER), PSC 81, APO AE 09724

SUBJECT: Draft STANAG 4382 (EDITION 2) – “SLOW HEATING, MUNITION TEST  
PROCEDURE ”

Reference document, AC/310-D/197, 12 December 2001, SAB.

The U.S. Armed Forces ratifies the referenced agreement.

Ratification and implementation details are as follows:

IMPLEMENTATION

	Forecast Date	Actual Date
<u>RATIFICATION REFERENCE</u>	<u>NAVY ARMY AIR FORCE</u>	<u>NAVY ARMY AIR FORCE</u>
Memo, OUSD(A&T) DATED AS ABOVE	June 12, 2002	June 12, 2002


NATIONAL IMPLEMENTING DOCUMENT: MIL-STD-2105C

RESERVATIONS: None

COMMENTS: See attached DA Form 4797-R.

The point of contact is Mr. James E. Elliott, DSN 880-3047, commercial (973) 724-3047.

1 Encl. as

  
Anthony J. Melita  
U.S. Key Delegate  
AC/310 Main Group



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Comments to STANAG 4382E2

NO (a)	NATION (b)	PAGE (c)	PARA (d)	LINE (e)	COMMENT (S) (f)	REASON(S) (g)
1	U.S.	1	1.a.	2	COMMENT: Change to read as follows, '...thermal environment at a change rate of 3.3°C per hour''	Necessary to clarify the intent that the temperature of the munition must be raised at a rate of 3.3°C per hour.
2	U.S.	5	18.a.	2	COMMENT: Delete reference to UN test 7f. It should read as follows; (UN Test 7h)	UN test 7f should not be referenced because it is an EIDS test. Only UN test 7h is applicable to articles.

REVERSE OF DA FORM 4797-R, DEC 88

Encl 1



NATO/PfP UNCLASSIFIED

12 December 2001

DOCUMENT  
AC/310-D/197

**GROUP ON SAFETY AND SUITABILITY FOR SERVICE (S3)  
OF MUNITIONS AND EXPLOSIVES (AC/310)**

**CNAD PARTNERSHIP GROUP (CPG)**

**RATIFICATION DRAFT 1 - STANAG 4382 (EDITION 2)  
SLOW HEATING, MUNITIONS TEST PROCEDURES**

**Memorandum by the Assistant Secretary General for Defence Support**

**(RATIFICATION REQUEST)**

Reference: PfP(CPG-S/3-SG/3)DS/8 dated 30 November 2001

1. The Group on Safety and Suitability for Service of Munitions and Explosives, Sub-Group 3, approved, at reference, draft STANAG 4382 (Edition 1) for issue for ratification.
2. In line with the decision of the Group, the agreed text is herewith forwarded to delegations of NATO nations who are requested to obtain the national ratification by 15 June 2002. The delegations are asked to inform the Defence Support Division of their national Ratification references, together with a statement of the date by which national implementation is intended to be effective, using the ratification response form at Annex. The service or services within which the standard applies should be indicated.
3. Most national Ministries of Defence contain a standardization office or standardization liaison officer who can give advice on the procedure to be adopted to obtain a formal ratification reference. It is recommended that contact be made with that office.
4. As soon as sufficient ratifications have been received, this STANAG will be forwarded for promulgation.

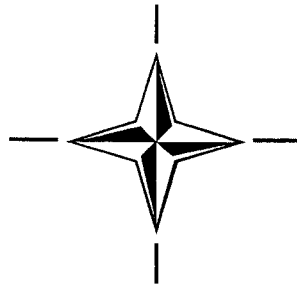
(Signed) R. G. BELL



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AC/310-D/197

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(Edition 2)  
(Ratification Draft 1)

**NORTH ATLANTIC TREATY ORGANIZATION  
(NATO)**



**NATO STANDARDIZATION AGENCY  
(NSA)**

**STANDARDIZATION AGREEMENT  
(STANAG)**

SUBJECT: SLOW HEATING, MUNITIONS TEST PROCEDURES

Promulgated on 2001

Jan H ERIKSEN  
Rear Admiral, NONA  
Director, NSA

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(Ratification Draft 1)

RECORD OF AMENDMENTS

No.	Reference/date of amendment	Date entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Director, NSA under the authority vested in him by the NATO Military Committee.
2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.
3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "In NATO Standardization, the fulfilment by which a member nation formally accepts, with or without reservation, the content of a Standardization Agreement" (AAP-6).
5. Implementation is "In NATO Standardization, the fulfilment by a member nation of its obligations as specified in a Standardization Agreement" (AAP-6).
6. Reservation is "In NATO Standardization, the stated qualification by a member nation that describes the part of a Standardization Agreement that it will not implement or will implement only with limitations" (AAP-6).

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7. Page (iii) gives the details of ratification and implementation of this agreement. If no details are shown it signifies that the nation has not yet notified the tasking authority of its intentions. Page (iv) (and subsequent) gives details of reservations and proprietary rights that have been stated.

FEEDBACK

8. Any comments concerning this publication should be directed to NATO/NSA - Bvd Leopold III, 1110 Brussels - BE.

**RATIFICATION AND IMPLEMENTATION DETAILS**  
**STADE DE RATIFICATION ET DE MISE EN APPLICATION**

N A T I O N A L P A Y S	NATIONAL RATIFICATION REFERENCE	NATIONAL IMPLEMENTING DOCUMENT	IMPLEMENTATION/MISE EN APPLICATION					
	REFERENCE DE LA RATIFICATION NATIONALE	DOCUMENT NATIONAL DE MISE EN APPLICATION	INTENDED DATE OF IMPLEMENTATION			DATE IMPLEMENTATION WAS ACHIEVED		
			DATE ENVISAGEE DE MISE EN APPLICATION			DATE EFFECTIVE DE MISE EN APPLICATION		
			NAVY MER	ARMY TERRE	AIR	NAVY MER	ARMY TERRE	AIR
BE								
CA								
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NAVY/ARMY/AIR

NATO STANDARDIZATION AGREEMENT  
(STANAG)

SLOW HEATING, MUNITIONS TEST PROCEDURES

Annexes: None.

Related documents:

AOP-38	Glossary of Terms and Definitions Concerning the Safety and Suitability for Service of Munitions, Explosives and Related Products
AOP-39	Guidance on the Development, Assessment and Testing of Insensitive Munitions.
STANAG 4123	Determination of the Classification of Military Ammunition and Explosives – AASTP-3
STANAG 4439	Policy for Introduction, Assessment and Testing for Insensitive Munitions
United Nations document (UN) ST/SG/AC.10/11/ Rev 3/R.256	Recommendation on the Transport of Dangerous Goods. Manual of Tests and Criteria

AIM

1. The aim of the agreement is:
  - a. To provide a standard test procedure (Procedure 1) for assessing the reaction, if any, of munitions and weapon systems to a gradually increasing thermal environment at 3.3°C per hour;
  - b. To provide an alternative, tailorable, test procedure (Procedure 2) for assessing the reaction, if any, of munitions and weapon systems to a gradually increasing thermal environment as determined by means of a Threat Hazard Assessment (THA).

AGREEMENT

2. Participating nations agree that Procedure 1, as incorporated in this STANAG, will be applied on a mandatory test for hazard classification (HC) purposes and may also be used as a standard test for determining the reaction, if any, of munitions and weapon systems to a gradually increasing thermal environment. Procedure 2 may also be used when a tailored heating rate is justified. National orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purpose of identification. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

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### DEFINITIONS

3. See AOP-38 for the definitions of terms used in this document.

### GENERAL

4. Effort to minimise the reaction of munitions to fire, and to maximise the time to this reaction, is a continuing commitment of weapons designers in order that the safety of personnel and materiel will not be jeopardised.

5. The objective of the selected Slow Heating Test is the assessment of the reaction and time to reaction, if any, of a munition(s) when subjected to a slow heating environment.

### DETAILS OF THE AGREEMENT

6. Application. This STANAG provides guidance and procedures for slow heating tests. The procedures should be conducted by participating nations as a part of the Insensitive Munition (IM) evaluation of munitions where required by STANAG 4439. The procedures may also be used for Hazard Classification (HC) (STANAG 4123), and other applications not covered by STANAG 4439, but where the response of a munition to slow heating is required to be assessed. When intended to satisfy both IM and HC requirements, the test plans should be coordinated with appropriate authorities in these two areas.

### TEST FACILITIES

7. Limitations. These procedures do not represent any particular high temperature situation. Should it be desired to represent a particular in-service or accident situation, procedure 2 may be modified to reflect the actual requirements, for example, vehicle, fuel, heating rate, and test configuration.

8. Special Notes. In slow heating tests, a substantial part of the explosive material may reach hazardous temperatures before ignition occurs. Therefore, subsequent events are likely to be more violent than those that occur in fast heating tests.

9. Standard Test Item. For the tests, the item tested must be to the full production standard, although non-explosive sections of the item need only be geometrically and thermally representative. For all-up rounds that contain more than one major energetic component (such as rocket motors and warheads), the energetic components may be tested either individually or as an all-up round. The item may be either packaged or unpackaged, as agreed by the appropriate national authorities.

10. Simulants. The use of simulants, dummy units or structures may result in a change in the heat flow patterns expected for the actual service item. Simulants may have different thermal properties than normal service items. Accordingly, any simulants used must have demonstrated comparable behavior to that of the real Service-built, standard items that they represent. Similarly, complex electronic units should be thermally simulated only if it can be demonstrated independently that there is no possibility of the heating environment causing the unit to produce a spurious signal capable of initiating a firing circuit.

11. Test Requirements. There are two procedures for performing the Slow Heating Test. Regardless of which procedure is followed, a minimum of two tests will be performed, with one test item per test, unless otherwise determined by national authorities. If the item is tested in its shipping container and, therefore, is not visible to a video camera, it is strongly recommended that a supplementary test be performed without the shipping container.

- a. Procedure 1 (Standard Test). Using the facility, test set-up, and instrumentation specified herein and in the Test Plan, subject the test item to gradually increasing temperatures, at a rate of 3.3°C/hour, until a reaction occurs, and record its reaction as a function of time and temperature. Prior to starting, adjust the chamber temperature at a rate of approximately 5°C/minute and precondition the test item at 50°C for 8 hours or until the test item reaches thermal equilibrium at 50°C, whichever occurs first.
- b. Procedure 2 (Tailored Test). Preconditioning is not required with this procedure. Real scenarios for slow heating can lead to many heating rates. If an analysis suggests that a particular heating rate is appropriate for the test item, that heating rate may be used in this test, and that analysis should be provided with the data. If no analysis has been done, a rate of 25°C per hour should be used as a default rate. This rate is believed to be near the lower limit of situations that are likely to occur as a result of indirect exposure to fire. However, if developers want the test to be applicable for HC purposes, the heating rate must be reduced to 3.3 °C per hour in accordance with UN Hazard Classification procedures.

12. Test Facility. The test is usually performed by placing the test item in a disposable oven and heating the item with circulating heated air. The test facility shall be capable of increasing the air temperature at the prescribed rate throughout the anticipated temperature range and maintaining a reasonably uniform temperature in the air around the test item. Some gradient in temperature between the input and exit air streams is to be expected, but this should not be greater than 5°C. As an aid to achieving uniform temperatures, there should be an air space at least 200 mm wide on all sides of the item to allow for air circulation, and the oven should be insulated. A minimum of four thermocouples should be used to be sure that the oven is uniformly heated and to monitor the surface temperature of the test item. Where it is possible to get access to the interior of the test item without altering the test item, interior temperatures should also be measured. In general, there should be at least two thermocouples mounted on opposite surfaces of the test item, one each in the air space near the air inlet and exit, and one each in the air space on opposite sides of the round (see Figure 1). The oven should be constructed so as to provide the least possible confinement for any reactions that occur, and it should have a window to permit video coverage.

13. Instrumentation (prior to reaction). Temperature as a function of time should be recorded at multiple positions as described in the preceding paragraph. The thermocouple sampling rate should be at least once per minute. If the munition is not in a shipping container, video coverage of the munition prior to reaction should be obtained. This can reveal changes in the physical structure of the munition (movement of shaped charge liners, for instance) prior to reaction, and sometimes reveals exudation of the energetic material, or other factors which may be important in interpreting the test results. Still photographs of the test setup should also be obtained.

14. Instrumentation to assess reaction type. Depending on the size and type of munition, various techniques can be used to assess the violence of the reaction and to assign a reaction type (see AOP-39). The best instrumentation for this purpose must be chosen by the test engineers based on their experience and judgement, but the following techniques should be considered for IM (see STANAG 4439) or HC (see STANAG 4123) assessments:

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- a. Airblast Overpressure. Measurement of airblast pressures is strongly recommended. Ideally, the gauges should be calibrated by detonating the test munition in its test configuration in an oven so that the maximum output from a Type I reaction is known. The presence of the oven will affect the blast pressure, so the oven should be as light as possible. Several "pencil-type" gauges mounted off-the-ground, at different distances from the test item, are recommended. The best results are usually obtained when the distance from the event to the line of gauges is such that the expected blast overpressure ranges from 3.5 to 70 kPa.
  - b. Witness Plates. Witness plates are often useful. Use witness plates strong enough to withstand a detonation of the test item. However, the optimum material to use for a witness plate depends on the type and velocity of the expected fragments. For heavy munitions with steel walls, a steel witness plate with a thickness of at least 25mm is recommended. However, for munitions with aluminum skins or very thin steel skins, an aluminum witness plate may work better. For munitions with plastic or composite skins, witness plates may not be useful. Normally, witness plates should not be in direct contact with the round since this might alter the heat flow into the round and the confinement of the energetic material. Ideally, there should be 200 mm between the witness plate and the test munition so as not to interfere with the uniform heating of the munition. Witness plates may affect the air blast from a munition, so it is best if there is no witness plate in the direction of the blast instrumentation.
  - c. Fragment Recovery. Recovered fragments can be useful in assessing the type of reaction. In some cases, it may be useful to put up fragment recovery panels (soft fiber board or plaster panels which stop fragments without breaking them). If used, these might replace one of the witness plates, but they should be outside of the oven. A map showing the location and type of recovered fragments may also be useful, but it must be recognized that the presence of the oven may affect the distance that fragments are thrown.
  - d. Photography. Still photographs of debris are useful for assessing reaction type.
  - e. Video. In addition to the close up video of the munition prior to reaction, a second video from a greater distance is useful. The field of view should be such that the ejection of debris and the fireball, if one forms, can be seen.
15. Constraints. Range safety may require that some items be constrained so that propulsive reactions don't carry them off the range. If so, the constraints should be designed to have a minimal effect on heat transfer to the munition or on the confinement of the munition. If used, constraints may interfere with the assessment of propulsive reactions. The assessment of propulsive reactions when constraints are used is a difficult problem which test engineers must consider on a case-by-case basis.
16. Observations and records. As a minimum, the following observations are to be made and reported in the test report:
- a. Test identification (model, serial number, etc.);
  - b. Type of energetic material and weight;
  - c. Photographs of the test setup;
  - d. Listing of environmental preconditioning tests performed;
  - e. Thermocouple identification and locations;
  - f. Thermocouple data for all sensors;

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- g. A record of events versus time and temperature through the end of the trial;
- h. The nature of any reactions by the test item, including indication of propulsion;
- i. Blast pressure records;
- j. Photographs of after test residue and debris;
- k. Photographs of witness plates (if used);
- l. Debris map;
- m. Number and depth of penetrations in fragment recovery panels (if used);
- n. Video and sound track.

17. Data obtained from this test must not be factored with respect to either temperature or time in order to derive forecasts of performance in other situations, which may involve lower temperature or heat flux levels. Rates of heat flow and thermal gradients within complex assemblies can become non-linear when changes of state and/or the loss of integrity of internal structures and components occur.

18. Evaluation of test results. Guidance is given in:

- a. UN document ST/SG/AC.10/11/ Rev 3/R.256. Recommendation on the Transport of Dangerous Goods. Manual of Tests and Criteria (UN tests 7f and 7h);
- b. STANAG 4439, Policy for Introduction, Assessment and Testing for Insensitive Munitions.
- c. AOP-39, Guidance on the Development, Assessment and Testing of Insensitive Munitions.

#### IMPLEMENTATION OF THE AGREEMENT

19. This STANAG is considered to be implemented by a nation when that nation has issued the necessary orders/instructions:

- a. that all future munitions and weapon systems will be assessed/tested in accordance with this agreement;
- b. to provide its NATO forces with the details in this agreement with reference to this STANAG.

20. Data developed in accordance with this STANAG shall be made available to other NATO Nations participating in a collaborative weapon development or procurement program, upon receipt of a request submitted through appropriate National channels.

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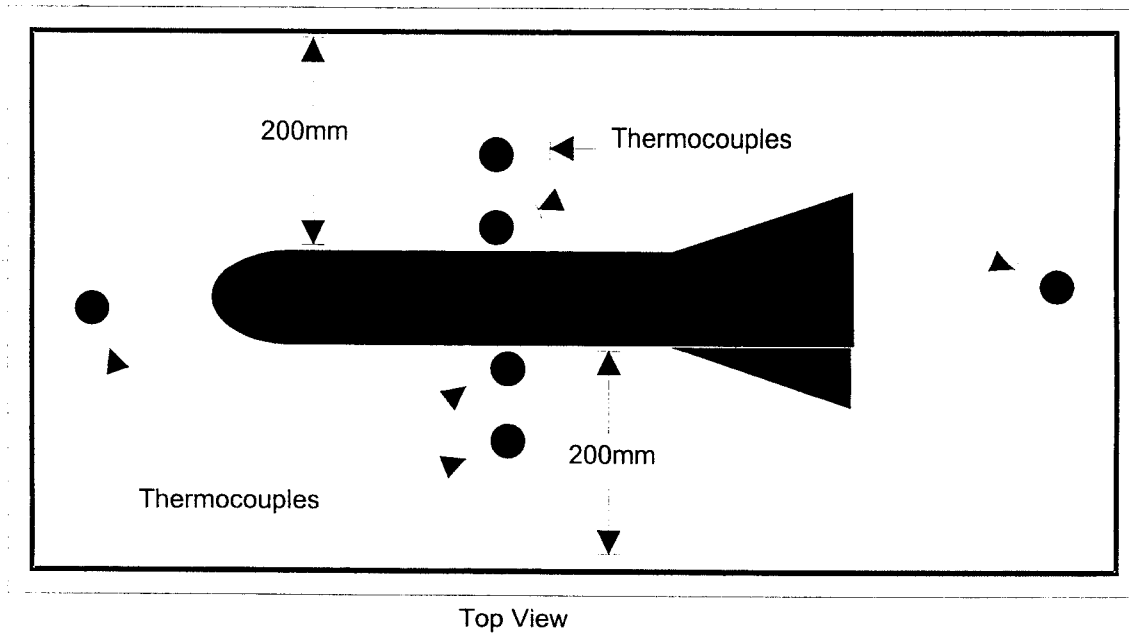
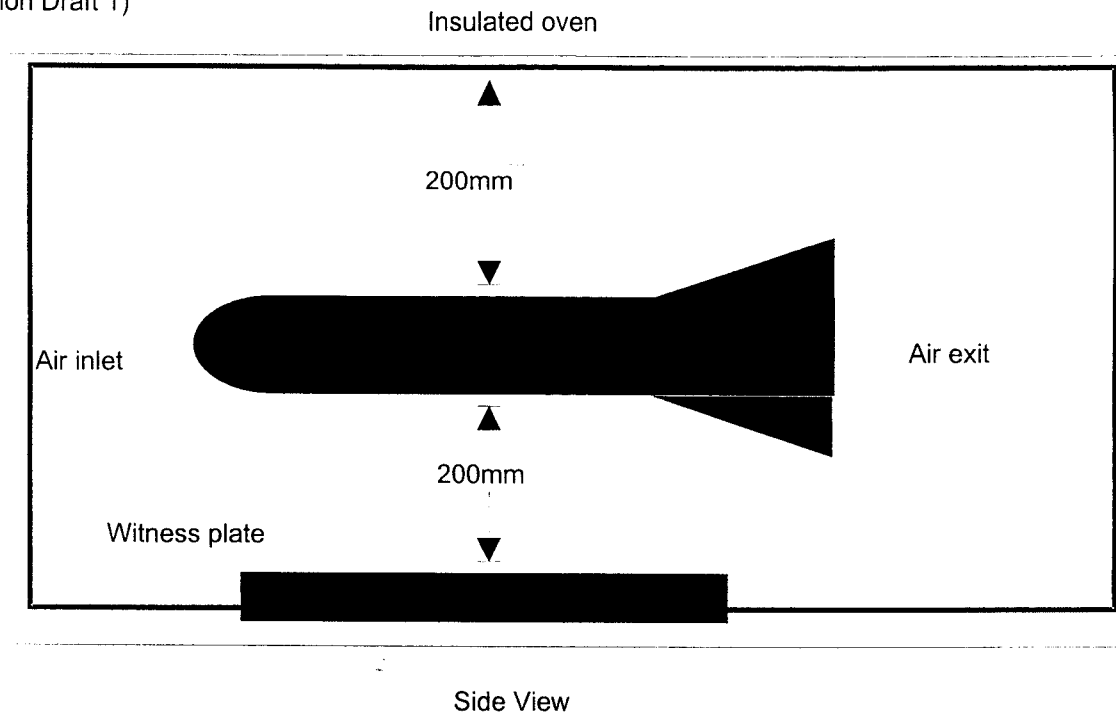


Figure 1. - Schematic drawing of a slow heating test setup.

NATIONAL REPLY ON THE RATIFICATION AND  
IMPLEMENTATION OF A STANAG

(National Reference and Date)

To : Assistant Secretary General for Defence Support  
NATO/OTAN

Subject : STANAG 4382 (Edition 2) - RATIFICATION DRAFT 1 – SLOW HEATING, MUNITIONS  
TEST PROCEDURES

Reference : AC/310-D/197 dated 12 December 2001

1. (nation) ratifies/does not ratify(\*) the agreement received under cover reference.
2. Ratification and implementation details are as follows:

RATIFICATION REFERENCE AND DATE	IMPLEMENTATION					
	Forecast Date			Actual Date		
	NAVY	ARMY	AIR	NAVY	ARMY	AIR

3. NATIONAL IMPLEMENTING DOCUMENT(s):

4. RESERVATIONS:

5. OTHER INFORMATION:

.....  
(Signature block)

(\*) Delete as appropriate

